

Claims

What is claimed is:

1. A fuel injector nozzle insert comprising:  
a metallic body having a first end separated from a second end by a circumferential side surface, at least one nozzle outlet that opens through said first end, and at least one passage opening through said second end;  
a portion of said at least one passage being an annular valve seat on said metallic body;  
said circumferential side surface including an annular valve surface positioned between a first cylindrical surface and a second cylindrical surface.
2. The nozzle insert of claim 1 wherein said side surface includes a planar tube abutment surface adjacent and perpendicular to said second cylindrical surface.
3. The nozzle insert of claim 1 wherein said annular valve surface includes a frustoconical portion.
4. The nozzle insert of claim 1 wherein said first cylindrical surface has a guide length and a guide diameter that is smaller than said guide length.
5. The nozzle insert of claim 1 wherein said second cylindrical surface has a mating length and a mating diameter that is smaller than said mating length.

6. The nozzle insert of claim 1 wherein said at least one nozzle outlet includes a plurality of nozzle outlets that are oriented into at least one of a non-impinging spray pattern and an impinging spray pattern.

7. The nozzle insert of claim 6 wherein said circumferential side surface includes a planar tube abutment surface adjacent and perpendicular to said second cylindrical surface;

said first cylindrical surface has a guide length and a guide diameter that is smaller than said guide length; and

said second cylindrical surface has a mating length and a mating diameter that is smaller than said mating length.

8. A needle valve member for a fuel injector comprising:

a nozzle insert having an external valve surface, an internal valve seat and at least one nozzle outlet;

a tube irreversibly attached to said nozzle insert.

9. The needle valve member of claim 8 wherein said nozzle insert includes one of a cylindrical male mating surface and a cylindrical female mating surface; and

said tube having an other of said cylindrical male mating surface and said cylindrical female mating surface mated to said nozzle insert.

10. The needle valve member of claim 8 wherein said tube includes an external surface with a first diameter adjacent said nozzle insert and a second diameter away from said nozzle insert; and

said first diameter is smaller than said second diameter.

11. The needle valve member of claim 8 wherein said at least one nozzle outlet includes a plurality of nozzle outlets that are oriented into at least one of a non-impinging spray pattern and an impinging spray pattern.

12. The needle valve member of claim 8 wherein said nozzle insert has a circumferential side surface that includes said external valve surface positioned between a guide cylindrical surface and a mating cylindrical surface.

13. The needle valve member of claim 12 wherein said guide cylindrical surface has a guide length and a guide diameter that is smaller than said guide length.

14. The needle valve member of claim 12 wherein said mating cylindrical surface has a mating length and a mating diameter that is smaller than said mating length.

15. The needle valve member of claim 8 wherein said tube includes an external surface with a first diameter adjacent said nozzle insert and a second diameter away from said nozzle insert, and said first diameter is smaller than said second diameter;

said at least one nozzle outlet includes a plurality of nozzle outlets that are oriented into at least one of a non-impinging spray pattern and an impinging spray pattern.

16. The needle valve member of claim 15 wherein said nozzle insert has a circumferential side surface that includes said external valve surface positioned between a guide cylindrical surface and a mating cylindrical surface;  
said guide cylindrical surface has a guide length and a guide diameter that is smaller than said guide length; and  
said mating cylindrical surface has a mating length and a mating diameter that is smaller than said mating length.

17. A method of making a needle valve member for a fuel injector, comprising the steps of:

forming a nozzle insert to include an annular valve seat and an annular valve surface;

machining at least one nozzle outlet through an end of said nozzle insert; and

irreversibly attaching said nozzle insert to a tube.

18. The method of claim 17 wherein said forming step includes a step of shaping the nozzle insert to include a cylindrical mating surface and a cylindrical guiding surface that share a common centerline with said annular valve surface and said annular valve seat.

19. The method of claim 17 wherein said at least one nozzle outlet includes a plurality of nozzle outlets; and

said machining step includes a step of orienting said plurality of nozzle outlets to have at least one of a non-impinging spray pattern and an impinging spray pattern.

20. The method of claim 17 wherein said irreversibly attaching step includes the steps of:

press fitting a male cylindrical surface on said nozzle insert into a female cylindrical surface in said tube; and

welding said nozzle insert to said tube.